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(54) LAMINATED HEAT EXCHANGER

LAMINATWÄRMETAUSCHER

ECHANGEUR DE CHALEUR A STRUCTURE STRATIFIEE

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Description

The invention relates to a layer-built heat exchanger comprising a first-side plate having plural channels for coolant flow formed by dividers on a flat rectangular panel, a hole at one end of the channels, and a hole on a diagonal line to the first hole on a different side of the plate, a second-side plate having plural channels for coolant flow formed by dividers on a flat rectangular panel, a hole formed separately at one end of the channels continuously to the corresponding hole in the first-side plate, and a hole on a diagonal line to the first hole on a different side of the plate continuously to the corresponding hole in the first-side plate, and a seal plate between the first-side plate and the second-side plate. Such a heat exchanger is known from JP-A-61-243297.

The present invention is particularly used in a radiator for coolant oil in machine tools or in an air conditioner.

Demand has risen for layer-built heat exchangers capable of using chlorofluorocarbons (CFC) and water and oil coolants in combination as first and second coolants for exchanging heat between CFC and CFC, CFC and water, water and water, or oil and water. A conventional layer-built heat exchanger is described below with reference to Figs. 1 - 5 (Japanese Patent Laid-Open No. 61-243297).

As shown in the figures, the conventional layer-built heat exchanger 1 combines plural first-side plates 2, seal plates 3, and second-side plates 4 between end plates 5a and 5b. The inlet pipes 6,8 and outlet pipes 7,9 for the first and second coolants, respectively, are connected to the one end plate 5b.

The first-side plate 2 has a rectangular shape with a pair of round holes 10, provided offset from the center at each end of the plate, for the first coolant flow. A series of parallel and winding channels 11 are formed by dividers 12 for conducting the coolant from a position near the round hole 10 at one end of the first-side plate 2 to a position near the round hole 10 at the other end.

Holes 13 for the flow of the second coolant are also formed on a diagonal line on the first-side plate 2 on the sides different from those on which the round holes 10 are formed. Each hole 13 has a rectangular shaped area 14 and a semi-circular shaped area 15 at the middle of the long side of the rectangular shaped area 14.

The second-side plate 4 has a similar rectangular shape with a series of parallel and winding channels 16 formed by dividers 17 to conduct the coolant between the two round holes 18. These round holes 18 are formed correspondingly to the holes 13 in the first-side plate 2 with part of each hole 18 tracing the same arc as the semi-circular shaped area 15 of the corresponding hole 13 in the first-side plate 2. Holes 19 are also provided correspondingly to the round holes 10 in the first-side plate 2. Each hole 19 also consists of a rectangular shaped area 20 and a semi-circular shaped area 21 at the middle of the long side of the rectangular shaped area 20 such that part of each semi-circular shaped area 21 traces the same arc as the corresponding round hole 10 in the first-side plate 2.

The seal plate-3 has holes 22 and 23 similarly shaped to the corresponding holes 13 and 19 in the first- and second-side plates 2 and 4, respectively. The length of the rectangular shaped area 14 and 20 of the holes 13 and 19 is made long enough to cover the ends of each of the channels 11 and 16, respectively.

The plates are then assembled in successive layers in the order of first-side plate 2, seal plate 3, second-side plate 4, seal plate 3, first-side plate 2, seal plate 3, ... as shown in Fig. 5, and are sealed between the seal end plate 5a on one end and the end plate 5b provided with the first and second coolant inlet pipes 6,8 and outlet pipes 7,9.

With this construction the first coolant flows in through the inlet pipe 6, is diffused to the channels 11 of the first-side plate 2 in the rectangular shaped area of the hole 22 in the seal plate 3, and flows through the channels 11 to the hole 22 on the opposite side to flow out from the outlet pipe 7. Similarly, the second coolant flows in through the inlet pipe 8, is diffused to the channels 16 of the second-side plate 4 in the rectangular shaped area of the hole 23 in the seal plate 3, and flows out through the hole 23 on the opposite side to the outlet pipe 8.

Heat is exchanged between the first and second coolants through the seal plate 3, which is made from a material with good thermal conductivity for greater heat exchange efficiency.

When there is a pressure difference between the first and second coolants, the seal plate 3 tends to become deformed where the channels 11 of the first-side plate 2 and the channels 16 of second-side plate 4 are positioned one over the other through the seal plate 3 because the seal plate 3 is the only member separating the channels 11 and 16 of the first- and second-side plates 2 and 4. This deformation also interferes with the coolant flow. It is therefore necessary to increase the thickness H of the seal plate 3 to prevent this deformation. The overall size and cost of the heat exchanger therefore increase.

It is an object of the present invention to provide a layer-built heat exchanger of the kind as defined above which does not have the drawback of deformation of the seal plate under pressure of the coolants in the channels of the side plates.

According to the invention, a layer-built heat exchanger as defined in the preamble of the patent claim is characterized by the dividers of the channels in the second-side plate being positioned opposite the channels in the first-side plate, and the dividers of the first-side plate being positioned opposite the channels in the second-side plate, with the seal plate in between.

Fig. 1 is an oblique view of a conventional layer-built heat exchanger,

Fig. 2 is a plan view of the first-side plate in Fig. 1,
Fig. 3 is a plan view of the seal plate in Fig. 1,
Fig. 4 is a plan view of the second-side plate in Fig. 1,
Fig. 5 is a cross sectional view of line V-V in Fig. 1,
Fig. 6 is a cross sectional view corresponding to Fig. 5 for a layer-built heat exchanger according to an embodiment of the present invention,
Fig. 7 is a plan view of the first-side plate in Fig. 6,
Fig. 8 is a plan view of the seal plate in Fig. 6,
Fig. 9 is a plan view of the second-side plate in Fig. 6.

A preferred embodiment of the present invention will now be described below with reference to the accompanying Figs. 6 - 9. It is to be noted that like parts in the preferred embodiments and the prior art described above are referred to by like reference numbers, and further description of said like parts is omitted hereinbelow.

As shown in the figures, the layer-built heat exchanger 31 according to the present invention is an assembly of plural first-side plates 32, seal plates 3, and second-side plates 33 assembled in alternating layers and sealed between a first end plate 5a and a second end plate 5b, which comprises inlet/outlet pipes 6 and 8, so that the fluid can flow through the first-side plate 32 and the second-side plate 33 without leaking.

The first coolant flowing in from the inlet pipe 6 flows into the plural channels 36, divided by dividers 34, in the first-side plate 32, and flows out from the outlet pipe 7. Similarly, the second coolant flowing in from the inlet pipe (not shown) flows into the plural channels 37, divided by dividers 35, in the second-side plate 33, and flows out from the outlet pipe (not shown). Heat is exchanged through the seal plate 3 between the two different fluids flowing through the upper and lower plates.

Because the channels 37 of the second-side plate 33 are formed over the dividers 34 of the first-side plate 32, and the channels 36 of the first-side plate 32 are formed over the dividers 35 of the second-side plate 33, two seal plates 3 and the divider 34 of one second-side plate 33 or the divider 35 of one first-side plate 32 are positioned between any two channels 36 or channels 37. The thickness of the solid material located between the channels 36 or 37 becomes great, so as to prevent deformation of the seal plate 3 even when there is a high differential pressure between the first and second coolants. Thus, the coolant flow can be maintained.

Because the channels 37 of the second-side plate 33 are formed over the dividers 34 of the first-side plate 32, and the channels 36 of the first-side plate 32 are formed over the dividers 35 of the second-side plate 33, two seal plates 3 and one second-side plate 33 divider 34 or first-side plate 32 divider 35 are positioned between any two channels 37 or channels 36. The greater total seal plate 3 thickness between the channels 37 or 36 therefore prevents deformation of the seal plate 3 even when there is a high differential pressure between the first and second coolants, and the coolant flow can thus be maintained.

A layer-built heat exchanger according to the present invention is suited to exchanging heat between the first and second coolants of an air conditioner. It is also suited for exchanging heat from a working oil in machine tools and other machinery by circulation with another coolant such as water.

Claims

1. A layer-built heat exchanger (31) comprising: a first-side plate (32) having plural channels (36) for coolant flow formed by dividers (34) on a flat rectangular panel, a hole (10) at one end of the channels (36), and a hole (13) on a diagonal line to the first hole (10) on a different side of the plate; a second-side plate (33) having plural channels (37) for coolant flow formed by dividers (35) on a flat rectangular panel, a hole (19) formed separately at one end of the channels (37) continuously to the corresponding hole (10) in the first-side plate (32), and a hole (18) on a diagonal line to the first hole (19) on a different side of the plate continuously to the corresponding hole (13) in the first-side plate (32); and a seal plate (3) between the first-side plate (32) and the second-side plate (33); characterized by the dividers (35) of the channels (37) in the second-side plate (33) being positioned opposite the channels (36) in the first-side plate (32), and the dividers (34) of the first-side plate (32) being positioned opposite the channels (37) in the second-side plate (33), with the seal plate (3) in between.

Patentansprüche

1. Mehrschichten-Wärmetauscher (31)

   mit einer ersten flachen, rechteckigen Platte (32), die zwischen Trennstegen (34) eine Mehrzahl von Kanälen (36) für den Durchfluß von Kühlmittel, eine erste Öffnung (10) an einem Ende der Kanäle (36) und eine weitere Öffnung (13) auf einer Diagonallinie zur ersten Öffnung (10) auf einer anderen Seite der Platte aufweist;

   mit einer zweiten flachen, rechteckigen Platte (33), die zwischen Trennstegen (35) eine Mehrzahl von Kanälen (37) für den Durchfluß von Kühlmittel, eine erste, an einem Ende der Kanäle (37) und an die entsprechende Öffnung (10) der ersten Schichtart (32) anschließend getrennt angeordnete erste Öffnung (19) sowie eine weitere Öffnung (18) auf einer Diagonallinie zur ersten Öffnung (19) auf einer anderen

Seite der Platte an die entsprechende Öffnung (13) der ersten Schichtart (32) anschließend aufweist; und
mit einer Abdichtungsplatte (3) zwischen der ersten Platte (32) und der zweiten Platte (33);

dadurch gekennzeichnet, daß die Trennstege (35) der Kanäle (37) der zweiten Platte (33) gegenüber den Kanälen (36) in der ersten Platte (32) angeordnet und die Trennstege (34) der ersten Platte (32) gegenüber den Kanälen (37) der zweiten Platte (33) angeordnet sind, wobei die Abdichtungsplatte (3) dazwischen liegt.

Revendications

1. Echangeur de chaleur à structure stratifiée (31) comprenant : une plaque (32) d'un premier côté ayant plusieurs canaux (36) pour la circulation d'un réfrigérant formés par des cloisons (34) sur un panneau rectangulaire plat, un trou (10) à une extrémité des canaux (36) et un trou (13) sur une diagonale vers le premier trou (10) sur un côté différent de la plaque; une plaque du second côté (33) ayant plusieurs canaux (37) pour la circulation du réfrigérant formés par des cloisons (35) sur un panneau rectangulaire plat, un trou (19) ménagé séparément à une extrémité des canaux (37) continûment au trou correspondant (10) de la plaque du premier côté (32), et un trou (18) sur une diagonale vers le premier trou (19) sur un côté différent de la plaque continûment au trou correspondant (13) dans la plaque du premier côté (32); et une plaque formant joint (3) entre la plaque du premier côté (32) et la plaque du second côté (33), caractérisé en ce que les cloisons (35) des canaux (37) dans la plaque du second côté (33) sont placées de façon à être opposées aux canaux (36) de la plaque du premier côté (32), et les cloisons (34) de la plaque du premier côté (32) sont placées de façon à être opposées aux canaux (37) dans la plaque du second côté (33), la plaque formant joint (3) étant située entre elles.

FIG. 1

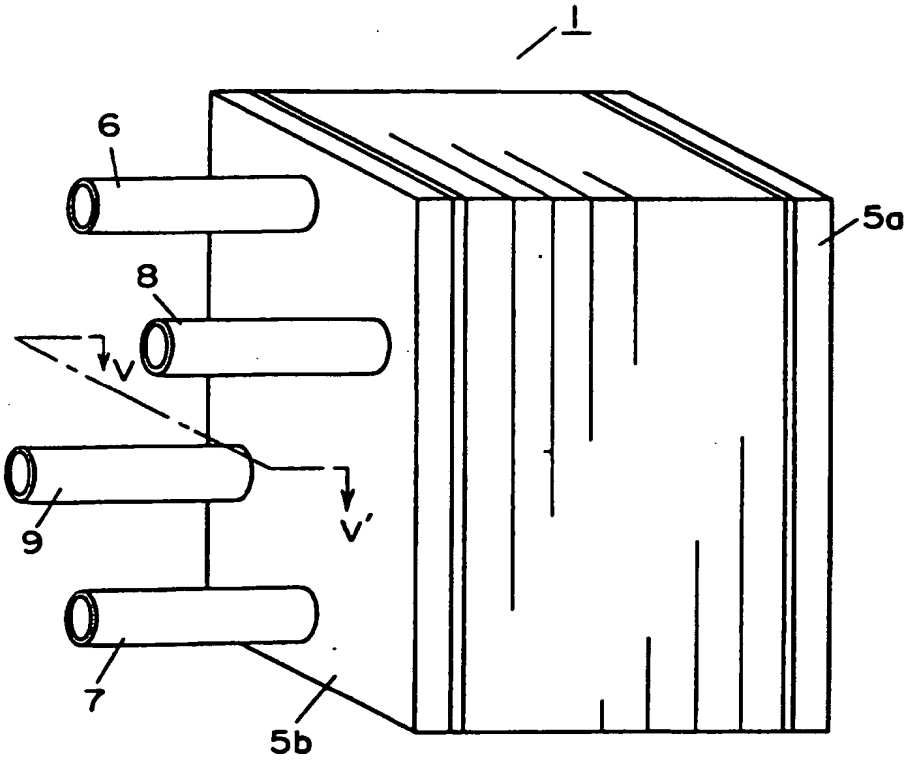

FIG. 4

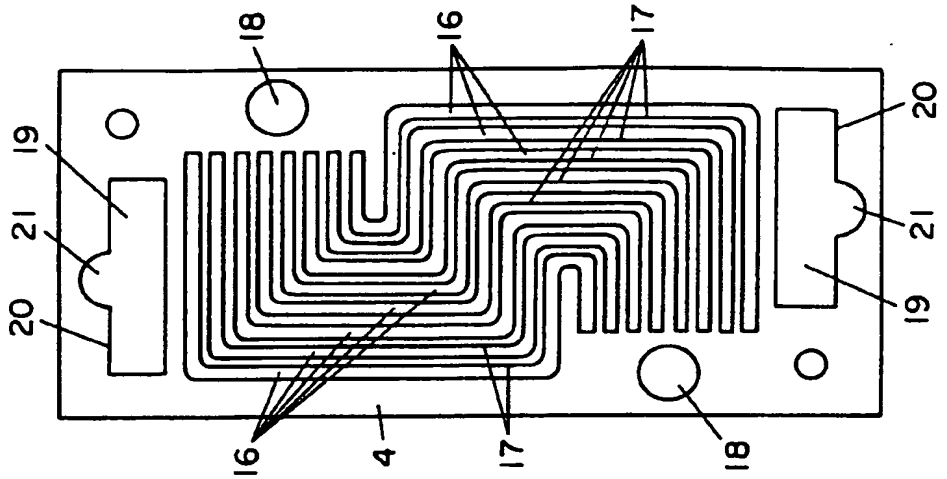

FIG. 3

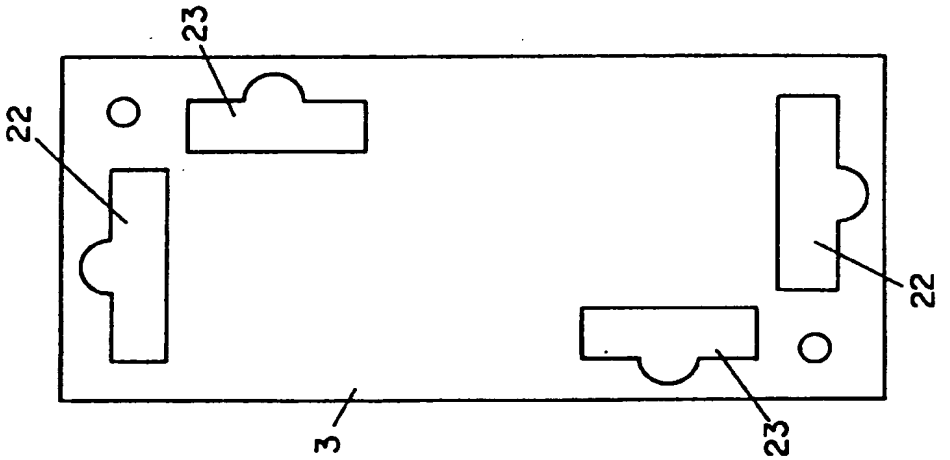

FIG. 2

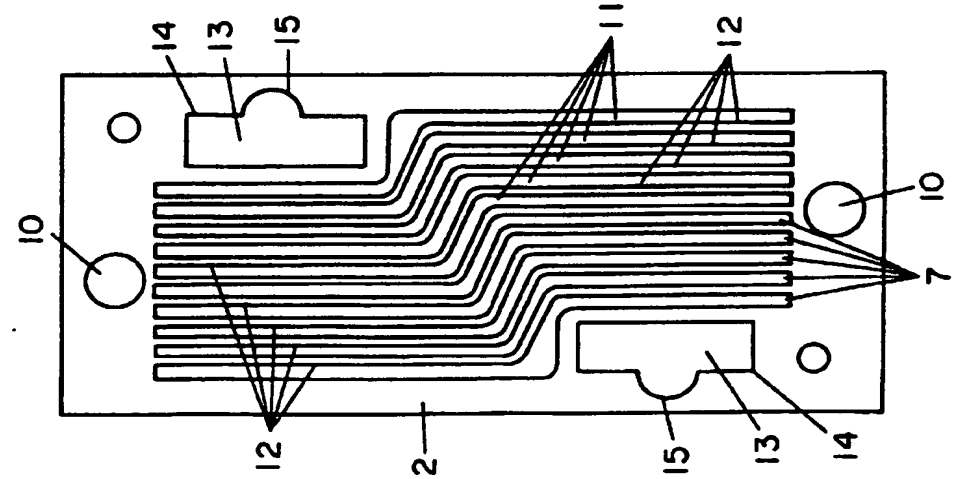

FIG. 5

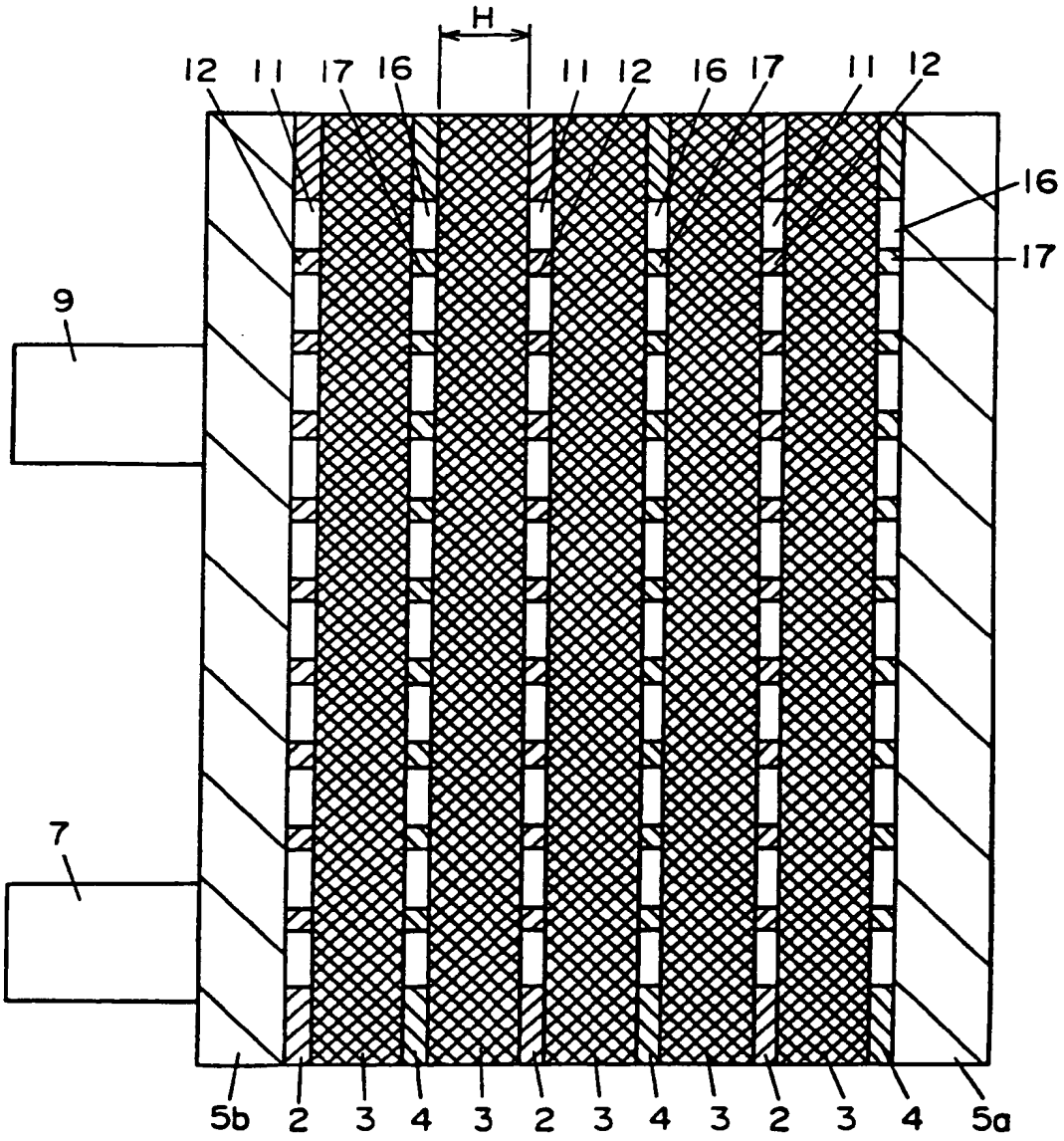

FIG. 6

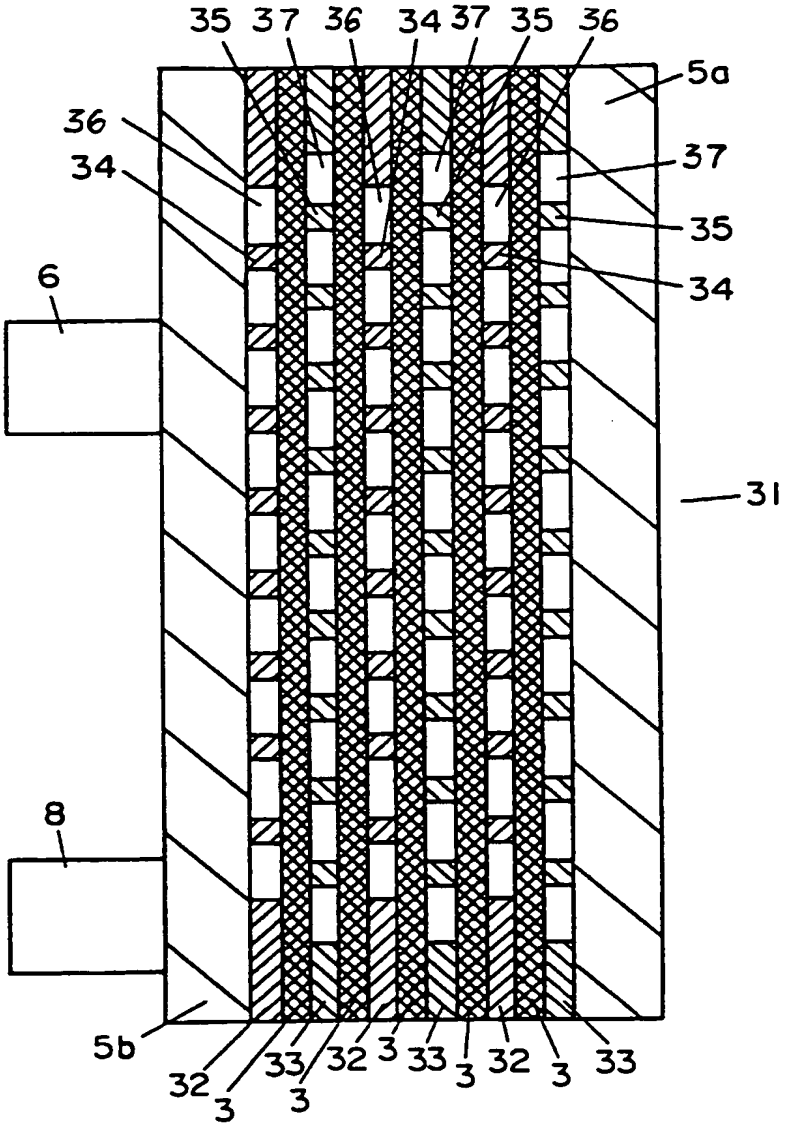

FIG. 9

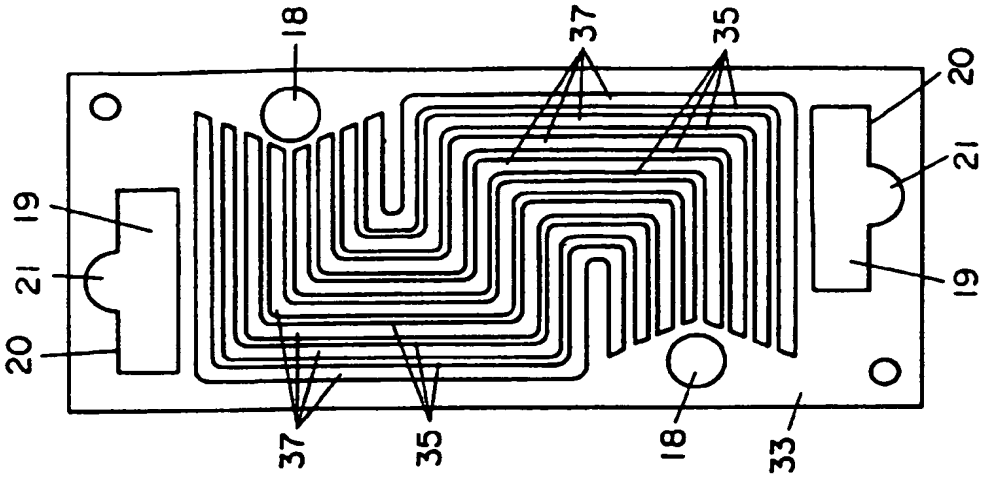

FIG. 8

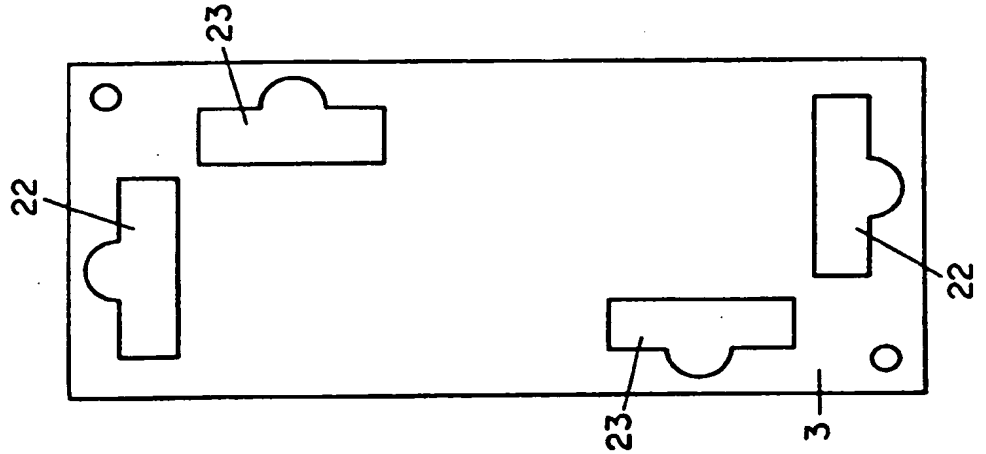

FIG. 7